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crystals, thus showing that the substance belonged to the latter class.

Action of Water of the Hubb Coal Mine upon Cast Iron: By F. W. DURKER. This mine was flooded and was filled with water for several years. When it was pumped out the iron work was found to have undergone a considerable change. The form was the same, but the substance was now porous, soft and easily cut with a knife. The changes which had taken place are explained as follows: the iron pyrites in the coal had been converted into ferrous sulphate, sulphuric acid and sulphur. The acid dissolved in the water and attacked the castings, forming the sulphates of the metals, hydrogen and hydrocarbons. The oxygen and carbon dioxide dissolved in the water formed oxides of iron, and the bars then consisted largely of silicon with oxides of iron on the outside.

The Action of Sulphuric Acid on Anisol: By W. B. SHOBER. Various results are found recorded concerning the action of sulphuric acid on anisol. The author studied the reaction under different conditions and found that anisol disulphonic acid is formed in every case in which anisol and sulphuric acid were heated to 92°; but not if they were heated above 125°. Paranisolmonosulphonic acid was always formed, while the ortho compound was formed when the substances were brought together at the ordinary temperature. This number also contains reviews of the 'Journal of Physical Chemistry;' 'Jahrbuch der Electrochemie;' 'Foods, their composition and analysis,' A. W. Blyth; 'The Elements of Electrochemistry,' M. Le Blanc. J. ELLIOTT GILPIN.

SOCIETIES AND ACADEMIES.

ZOOLOGICAL CLUB, UNIVERSITY OF CHICAGO.
MEETING OF DECEMBER 2, 1896.

THE meeting opened with a paper by Dr. O. P. Hay, on 'The Structure and Mode of Development of the Vertebral Column,' of which the following is an abstract:

A vertebra is in most, if not all, animals a composite structure, both in the early stages of ossification and in the preceding cartilaginous stage. The notochord, around which the vertebral centrum is developed, at a very early period secretes two sheaths, an outer one, the

elastica, and an inner thicker one, the proper chordal sheath. Any segmentation of the notochord or of its sheaths is due to the development of structures lying primarily outside of the sheaths and arranged metamerically. The skeletogenous cells arise from the lower half of the protovertebra, Gadow and Abbott to the contrary notwithstanding; from these cells arise the upper and lower arches and the intercalated cartilages. In the sharks, cells from the bases of the arches pierce the elastic and enter the chordal sheath, thus giving rise to the centra of these fishes. In the bony fishes, as Gegenbaur and Balfour have shown in *Lepidosteus*, Lotz in the salmon and Hay in *Amia*, the elements of the vertebral centra are developed wholly outside of the elastica. In the tail of *Amia* there are for each myomere eight cartilages resting on the elastica, the two halves of the upper arch, the two halves of the lower arch, the two upper intercalated cartilages, and the two lower intercalated cartilages. In the dorsal region these are all present except the lower intercalated cartilages, which seem to be missing.

A deposit of bone is formed in each of the eight pieces of each segment of the tail. The four bases of the upper and lower arches are thereby joined into one of the two rings found there in each segment, the so-called hypocentrum or intercentrum; similarly the four intercalated cartilages are joined to form the other ring, the so-called pleurocentrum. In the dorsal region the bases of the upper arch take no part in the formation of the centrum, being crowded upward on the top of the enlarged intercalated cartilages. Bone spreading from the latter cartilages meets bone advancing from the bases of the lower arch. Hence the vertebrae of the dorsal region are called pleuro-hypocentra.

In *Lepidosteus* the intercalated cartilages appear to be fused into a ring around the notochord and thus fused with the bases of the upper and lower arches. Later this ring of intercalated cartilages is divided, one-half going to the vertebra behind, the other half to the vertebra in front, and these, becoming ossified, form the articular ends of the adult vertebra.

In the Urodeles the two sheaths of the notochord are enveloped as in bony fishes. Hasse

and Field are in error when they affirm that the elastica is pierced by cells from the skeletogenous layer. What they claim as the elastica is not such. The intervertebral ring of cartilage seems to be formed of the fused intercalated cartilages, just as in *Lepidosteus*, and as in this fish becomes cross-segmented to form the articular ends of the adjacent vertebræ.

A paper* by Dr. H. C. Bumpus, giving results of a study on *meristic* and *homœotic* variation in the vertebral axis in *Necturus*, was briefly referred to by Professor Whitman.

The scope of the paper and method of dealing with the subject will be seen in the following questions raised and answered more or less fully by the author:

1. The per cent. of variation in the attachment of the pelvic arch. Is there meristic variation and is homœotic variation associated with it?
2. Is there a ratio between the absolute length of the animal and the number of vertebræ?
3. Why does the variation tend towards *forward* rather than *backward* homœosis?
4. Occurrence of oblique or unsymmetrical sacra.
5. Is the position of the pelvic arch dependent on the ordinal position of some one segment (sacrum), or is it determined by the location of some topographical point?
6. Are there variations in the position of the pectoral arch? and are these correlated with variations in the pelvic arch?
7. Are there other skeletal variations associated with pelvic variations?
8. Are variations more frequent in males than in females?
9. Are there anatomical grounds for the theory of vertebral intercalation?

These questions and many others raised in connection with them are answered by the conditions presented in one hundred specimens of *Necturus*.

Dr. Bumpus has used the expressions '*forward*' and '*backward homœosis*' as defined by Bateson ('Materials for the Study of Variation,' p. 111).

The pelvic arch is attached in the majority of

cases to the XIX. vertebra. The variation in position in most cases consists in attachment to the XX. vertebra, and this is called *forward* homœosis. The term 'homœosis' is an old one, and Bateson employs it in its strict etymological sense. It is not the term, but the method of defining *direction*, that is open to serious objection. It is decidedly confusing and contrary to general usage to speak of the direction of variation as forward when the homœosis is exhibited in vertebræ lying *behind* the starting point. 'According to Bateson's definition, if the pelvic arch in *Necturus* were found as far back of the normal position as the last caudal vertebra it would still be a case of forward homœosis. If the homœosis appeared in successive vertebræ, coming at each step nearer the caudal end, we should still have to defy common sense and call it 'forward.' Proceeding in this wise, we should have to speak of the formation of segments in an embryo as progressing forward, notwithstanding that we know that the development advances in just the opposite direction. From this point of view, the direction of developmental differentiation in general would be forward instead of backward.

"The development of petals in the form of sepals," as Bateson himself suggests, would be "an *outward* homœosis, while the formation of sepaloid petals would thus be called an *inward* homœosis, and so forth."

Is anything gained, except confusion, by adopting such terminology?

Bateson attempts to justify his position in the following words:

"In describing cases of such transformation in the series, it is usual to speak of structures, the pelvis for example, as 'travelling forward,' or 'travelling backward.' These modes of expression are to be avoided as introducing a false and confusing metaphor into the subject, for there is of course no movement of parts in either direction, and the natural process takes place by a development of certain segments in the likeness of structures, which in the type occupy a different ordinal position in the series. In using the expression, homœosis, we may in part avoid this confusion, and we may speak of the *variation as occurring from before backward or from behind forwards, according as the segment to*

* Soon to appear in the *Journal of Morphology*.

whose form an approach is made stands in the normal series behind or in front of the segment whose variation is being considered. The formation of a cervical rib on the seventh vertebra is thus a backward homœosis, for the seventh vertebra thus makes an approach to the characters of the 8th. On the other hand, development of ribs on the 20th vertebra (1st lumbar) is a forward homœosis, for the 20th vertebra then forms itself after the pattern of the normal 19th."

Curiously enough the main argument is, to avoid confusion. The confusion to be avoided, however, is wholly imported in the word 'travelling.' Drop the idea of movement of parts and use the terms of direction in their usual sense, and there is no confusion. The 'confusion worse confounded' comes in when a backward direction is called a forward one, and *vice versa*. When the 20th vertebra 'becomes like' the normal 19th, the locus of the variation is behind the normal, and the direction should be defined *from*, rather than *to*, the normal. The 20th vertebra 'becomes like' one in front of it, but that does not make the *direction of variation* forward.

NEW YORK ACADEMY OF SCIENCES, BIOLOGICAL SECTION, NOVEMBER 9, 1896.

MEMBERS of the Columbia University Expedition to Puget Sound made reports on the summer's work.

Mr. N. R. Harrington gave a short narrative of the expedition, including a description of the equipment of the laboratory, dredging, investigation and plankton collection. In addition he made a report on the echinoderms, crustaceans and annelids. Mention was made of the relation of the asymmetry in *Scutella excentricus* to its habit of burrowing and its vertical position in the sand. Abundant material, both larval and adult, of *Entoconcha*. This mollusc had been noted by Miller in 1852 and Baur in 1864 in *Synapta digitata* and by Semper in *Holothuria edulis*. The present material was found in an undetermined species of *Holothuria*. About forty species each of crustaceans, annelids and echinoderms have been identified.

Mr. Bradney B. Griffin presented the following report on the platodes, nemerteans and molluscs.

The Platodes and Gephyrea are relatively scarce. They are represented solely by two dendrocoels, and one phymosoma respectively. The nemertines occur very abundantly, fully fifteen different species were obtained, most of which appear to be undescribed, though some seem to approach more or less closely the European forms rather than those of the east coast of America. The Enoplan species are the more numerous. The molluscan fauna is very rich and varied, ninety-three species of sixty-nine genera were collected. These include, among others, the large *Cryptochiton stelleri*, which when alive and expanded measures over 20 cm., besides numerous smaller species of *Mopalia*, *Katherina*, *Tonicella*, etc., that occur in vast numbers on rocks and piles between tides. The nudibranchs are notable from their bright colors and large size. One species of *Dendronotus* attains a length of over 25 cm. Cases of color variation (*Cardium* and *Acmaea*) and color series (*Litorina*) were to be met with as well as color harmonization; many chitons and limpets are colored so as to more or less resemble the speckled and barnacled rocks upon which they occur. A complete series of *Pholadidea penita* (the 'boring clam') was obtained which shows the gradual atrophy of the foot and concrescence of the mantle edges as the adult condition is attained. Specimens of *Zirphæa crispata* were collected, a related form in which the foot remains functional throughout life. A series of maturation and fertilization stages of this form was obtained. *Lepton* is not uncommon, a lamellibranch that lives commensal, attached by its byssus to the abdomen of the crustacean *Gebia*, and has caused the trophy of the first pair of abdominal appendages of its host. It has developed a median furrow on each valve in adaptation to the body form of *Gebia*. An interesting case was observed in which an otherwise nearly smooth *Placuanomia* shell had assumed during its growth the concentric raised lines of a *Saxidomus* valve upon which it was attached.

The insects are not very abundant; they are represented in the collection mainly by a few wood beetles, myriopods (*Julus*, *Polydesmus*), and a species of *Termes*.

Mr. Calkins reported on the protozoa and coelenterates of Puget Sound and of the Alaskan Bays. The protozoa and coelenterates collected during the summer by Mr. Calkins belong chiefly to the group flagellata for the former, and to the leptomedusæ for the latter. In addition, there are two species of hydroids—a large number considering the very limited representation of this group in the western waters. Twelve or fourteen species of actinians and about the same number of sponges, and several scyphomedusæ complete the list of coelenterates.

Dr. Bashford Dean reported on the chorodates and protochordates of the collection. The ascidians are represented by about a species, fishes by upwards of forty. The most important part of his work had been the collecting of embryos and larvæ of *Chimæra* (*Hydrolagus colliet*) and a fairly complete series of embryos of *Bdellostoma*, including upwards of twenty stages from cleavage to hatching. Of *Chimæra* upward of eighty egg cases had been dredged in a single day; but in every case these were found to be empty. The eggs were finally obtained at Pacific Grove, California, from the gravid females and were incubated in submerged cages. It was in this locality that the eggs of *Bdellostoma* were collected.

C. L. BRISTOL,
Secretary.

GEOLOGICAL SOCIETY OF WASHINGTON.

At the 53d meeting, held in Washington, D. C., December 9, 1896, Mr. Whitman Cross gave an account of some unusually large landslides observed in the Telluride region of Colorado. The slides occur on the western face of the San Juan Mountains, where the San Miguel conglomerate and a thick series of volcanic beds rest upon Cretaceous shales. Water percolating through the upper beds has softened the shales and caused the slides.

It is clear that the slides occurred long ago when the topography of the mountain front was even more rugged than at present. Masses of rock two miles in length and more than 1500 feet in vertical dimension have slipped, apparently as a unit, for several hundred feet. In such cases the bedding of the mass dips to-

ward the mountain from which it was detached. Subsequent slides of portions of the original mass have greatly modified the relationships of the rocks.

Mr. W J McGee detailed certain observations on 'The Formation of Arkose.' The region in which the process was observed is the eastern shore of the Gulf of California or the western coast of the State of Sonora, Mexico, about latitude 29°. The region is one of broad plains, base-leveled by sheetflood erosion, these plains being relieved by notably rugged mesas and sierras. The rocks consist largely of granites and granitoid schists, evidently of considerable antiquity, together with considerable beds of igneous rocks, tuffs, etc., probably ranging from Mesozoic to middle Tertiary in age; in the mesas and sierras the rocks are practically bare, while in the flood-sweep plains they are veneered with a thin sheet of coarse alluvium, ranging from a few inches to a few yards in thickness, which becomes fine and of considerable thickness only in the axes of the greater valley plains. Between Puerto Infierno and Punta Ygnacio (mapped in National Geographic Magazine, Volume VII., 1896, plate xiv.) the gulf shore reveals a section of rocks and overlying mantle in a range of sea cliffs, averaging 30 or 40 feet in height between the lower ranges which jut into the gulf in such manner as to form prominent points; while the shore is skirted by a wave-cut bench or terrace lying slightly below extreme low tide, averaging some 100 yards in width, beyond which the gulf deepens rapidly. The prevailing rocks are slightly schistoid granites, while the alluvial veneer is composed chiefly of granitic products. The region is one of high tides and strong tidal currents, and is subject to strong winds, rising almost daily into gales, induced by general climatic and local topographic conditions; the climate is notably arid, and no fresh waters ever flow into the gulf save locally and for a few hours after the greatest storms. In the course of a visit to the coast in December, 1895, the speaker observed the rapid work of the waves in sapping the cliffs during a gale; and on one occasion, at low tide with an off-shore wind, he passed well toward the outer margin of the wave-cut terrace, examining the débris accu-

mulated in the depressions of the rugged surface; in most cases this was found to be a coarse granular sand, made up of crystals and angular fragments of quartz, felspar, mica, etc.; sometimes intermixed or superficially coated with finely comminuted and lixiviated material, but more commonly clean. It was impracticable to trace the character of the detritus below the level of extreme low tide; but everything indicated that examination beneath the waters of the gulf here would reveal considerable deposits, corresponding at least to the volume of material removed in forming the sea cliffs, which would be found to consist of such material as that observed. It was noted that off the prominent granitic points (six or seven of which were studied) the granitoid sand was coarsest and cleanest, while in the reentrants it was mixed with rounded sand and contained a larger element of comminuted material. The freshly-formed granitic sand differs from ordinary arkose, such as that of the Potomac formation, only in the more complete decomposition of the felspar and other constituents in the latter. The observations are considered of value as indicating the conditions under which arkose and mixtures of arkose with ordinary sand are produced.

Mr. Waldemar Lindgren summarized the results of his recent surveys of the mining districts of Nevada City and Grass Valley, in California, discussing the history of mining operations there, the geology, the mode of origin and character of the fissure systems, the products of vein formation, etc.

These important districts are situated on the western slope of the Sierra Nevada, in Nevada county, at an elevation of 2,500 feet, and within them are a great number of important gold deposits, consisting of quartz veins and gravels. The districts have been worked continuously since 1849. At present the quartz mining industries are by far the more important. The districts are estimated to have produced a total of \$113,000,000.

These districts together form the subject of a folio of the Geologic Atlas of the United States, but just issued from the press, as well as of a treatise, which will be published within a month as a part of the Seventeenth Annual Re-

port of the Director of the United States Geological Survey.

W. F. MORSELL.

U. S. GEOLOGICAL SURVEY.

BOSTON SOCIETY OF NATURAL HISTORY.

THE first general meeting of the season was held November 4th, one hundred and seventeen persons present.

Prof. George Lincoln Goodale spoke of the reclamation of deserts. The differences between deserts were described and their various aspects noted. The end of Cape Cod was cited as an example of a desert near at hand, and the scanty vegetation of Sable Island and the difficulty of inducing plants to flourish there were mentioned. The distribution of desert plants was noted, and the effects of aridity, the changes brought about by the introduction of water, and the various kinds of water in the soil, were fully described.

Views of typical deserts in Australia, Africa, and in other parts of the world were shown, Prof. Goodale concluding with an account of the effects of irrigation and of some of the practical difficulties arising therefrom.

SAMUEL HENSHAW,
Secretary.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science of St. Louis on the 7th of December, 1896, Prof. H. S. Pritchett presented a paper giving the results of measures of double stars, mostly close binaries, made with the 12½-inch equatorial of the Glasgow Observatory. These observations, compared with similar ones made by him fifteen years earlier, showed some remarkable changes, particularly in the case of 70 Ophiuchi, in which the companion had described an arc of 102°. Others, as Σ 2120, showed that the motion of the companion star was independent of the brighter one. The speaker gave a general statement of the method of measuring double stars and the method of determining the apparent and true orbits.

Mr. Wm. H. Roever presented an abstract of a paper on the geometrical properties of lines of force proceeding from electrical systems, in which he showed:

(a) That the curve representing a line of force

proceeding from a system consisting of an electrified plane and an electrified line parallel to the plane, is the locus of the intersection of two straight lines having motions in a plane which is perpendicular to the electrified line; one line having a motion of uniform rotation about the electrified line as an axis, and the other a motion of uniform translation perpendicular to itself and parallel to the electrified plane.

(b) That the curve representing a line of force proceeding from a system consisting of an electrified plane and an electrified point is the locus of intersection of two straight lines having motions in a plane, which passes through the electrified point and is perpendicular to the electrified plane; one line having a motion of rotation about the electrified point and the other a motion of translation perpendicular to itself and parallel to the electrified plane. The rotation is such that the versine of the angle which the rotating line makes with oy (a line which passes through the electrified point and is perpendicular to the electrified plane) changes at a uniform rate, and the translation is such that if the moving line were the meridian line of a cylinder of revolution whose axis is oy , the area of cross section of the cylinder would change at a uniform rate.

Mr. Roever also showed other properties of the above lines of force.

One active member was elected.

WILLIAM TRELEASE,
Recording Secretary.

SCIENCE CLUB AT THE UNIVERSITY OF WISCONSIN.

THE first regular meeting of the Science Club of the University of Wisconsin was held Tuesday, November 10th, the regular programme consisting of a discussion by E. A. Birge on 'The Crustacea of the Open Water of Lake Mendota,' and a paper on 'the Radiophone' by C. M. Smith. Mr. Birge, in speaking of the vertical distribution of the limnetic crustacea, enumerated the factors which effect the distribution, and illustrated the action of each factor by its effect on different species of the crustacea. Especial attention was called to the fact that in summer the crustacea do not descend below the

'Sprungschicht' of temperature, but stop abruptly at that level. This was regarded as due, not to temperature directly, but to the accumulation of decomposition products in the deeper water. Mr. Smith's paper reviewed the principal phenomena which have led to the conclusion that the production of sounds of definite pitch is a general property of all matter, whether solid, liquid or gaseous, when placed in the path of rapidly intermitted heat radiations; the pitch corresponding to the rapidity of interruptions of the rays. He further showed the application of the method to the study of emission and absorption phenomena.

WM. S. MARSHALL,
Secretary.

THE BOTANICAL SEMINAR OF THE UNIVERSITY OF NEBRASKA, DECEMBER 5, 1896.

The Polyphyletic Grouping of the Lichens, MR. CLEMENTS. *Mycological Statistics of Nebraska*, MR. POUND. *The Comparative Anatomy of the Pistil in Apocarpous Families*, MR. ERNST BESSEY. *Phytogeographical Notes from Colorado*, MR. SHEAR.

NEW BOOKS.

The Microscope and Microscopical Methods. SIMON HENRY GAGE. Ithaca, Comstock Publishing Co. 1896. Pp. xii+237. \$1.50.

The Principles of Sociology. HERBERT SPENCER. New York, D. Appleton & Co. 1896. Vol. III., pp. x+645. \$2.

List of the Vertebrated Animals now or lately living in the Gardens of the Zoological Society of London. London, Longmans, Green & Co. 1896. Pp. xvi+724.

Prehistoric Man and Beast. H. N. HUTCHINSON. New York, D. Appleton & Co. 1897. Pp. xxi+298. \$3.

A Text-book of Special Pathological Anatomy. ERNST ZIEGLER. Translated and edited from the Eighth German Edition by DONALD MACALISTER and HENRY W. CATTELL. New York and London, The Macmillan Co. 1896. Section I.-VIII. Pp. xix+575+xxxii.

Elementary Meteorology for High Schools and Colleges. FRANK WALDO. New York, Cincinnati and Chicago, The American Book Company. 1896. Pp. 372.